New Sources for Biofuels: What Are They?



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Framing the Future of Energy

- Significant growth is expected in global energy demand
- Adding and accelerating diversification is essential
- Scale matters and scaling up has effects
- Infrastructure development is often overlooked
- Renewable energy requires different business models
- Energy strategies and solutions require a holistic view, including addressing carbon constraints

For a comprehensive analysis of the future of energy to 2030, see the major new study at: *www.npc.org*

The Dimensions of Energy

Scale	Time	Capital
Global fuel volume: **Today:** • One thousand barrels per second • > 1 trillion gal/yr • 0.5 gal for every human, every day **Tomorrow – 2030** • Mid-range growth forecasts at + 50% • Low-range growth forecasts at +30%	Manufacturing and infrastructure: • Takes decades to develop at scale; lasts generations • Large ethanol plant: 100 MM gal/yr • Large crude refinery: 3000 MM gal/yr Technology: • Avg. >15 yrs from invention to large scale deployment	Estimates of future investment call for $20+ trillion over the next 30 years

Chevron's View of the Next Generation of Global Energy

Conventional Fuels

Finding and Developing the Next Trillion Barrels

Alternative Fuels

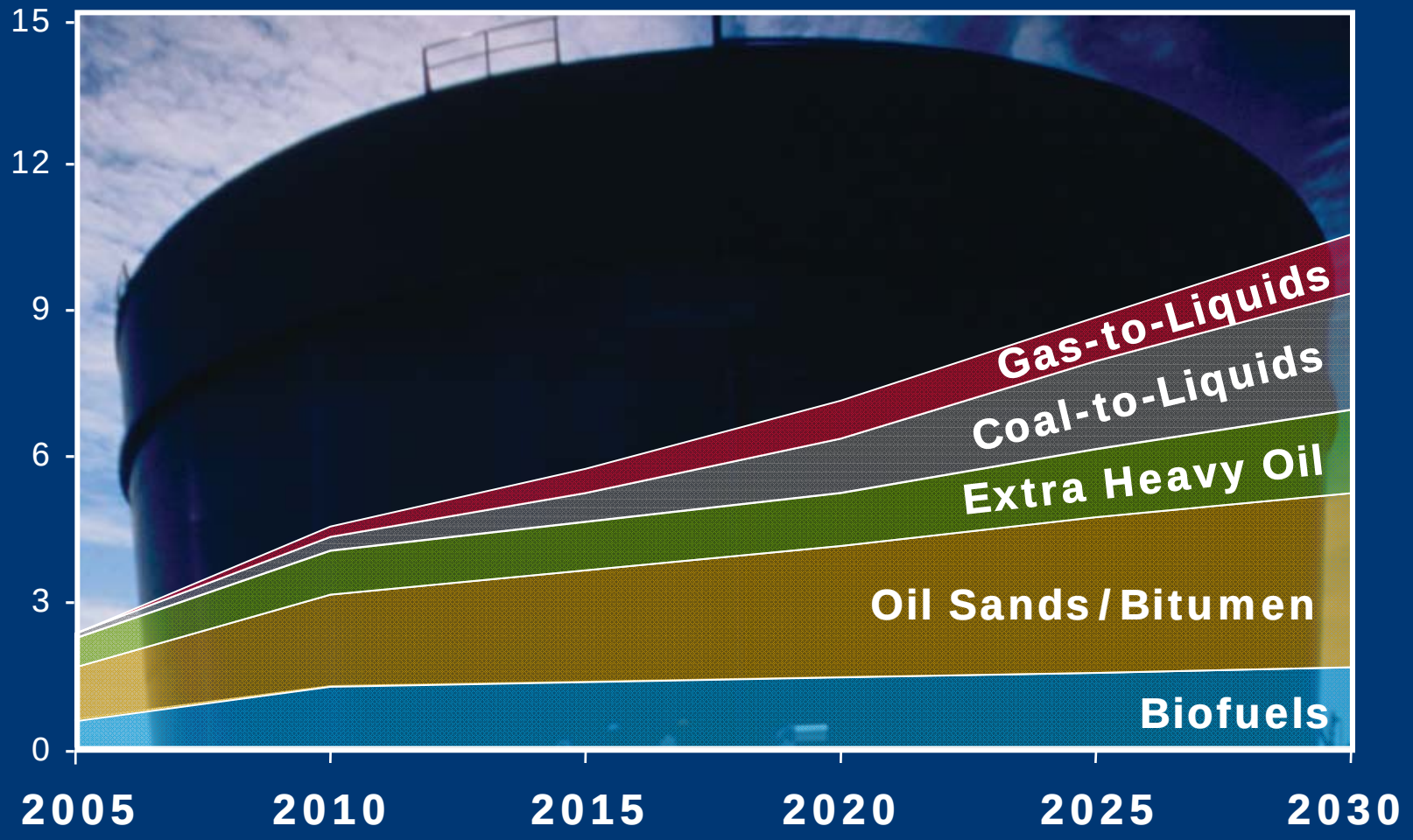
Converting Unconventional Resources with Molecular Transformation

Renewable Fuels

Building Industrial-Scale, Sustainable Business Models

Fuels from Unconventional Resources

Global Production - Million Barrels Per Day



Source: Data From EIA 2007 Reference.

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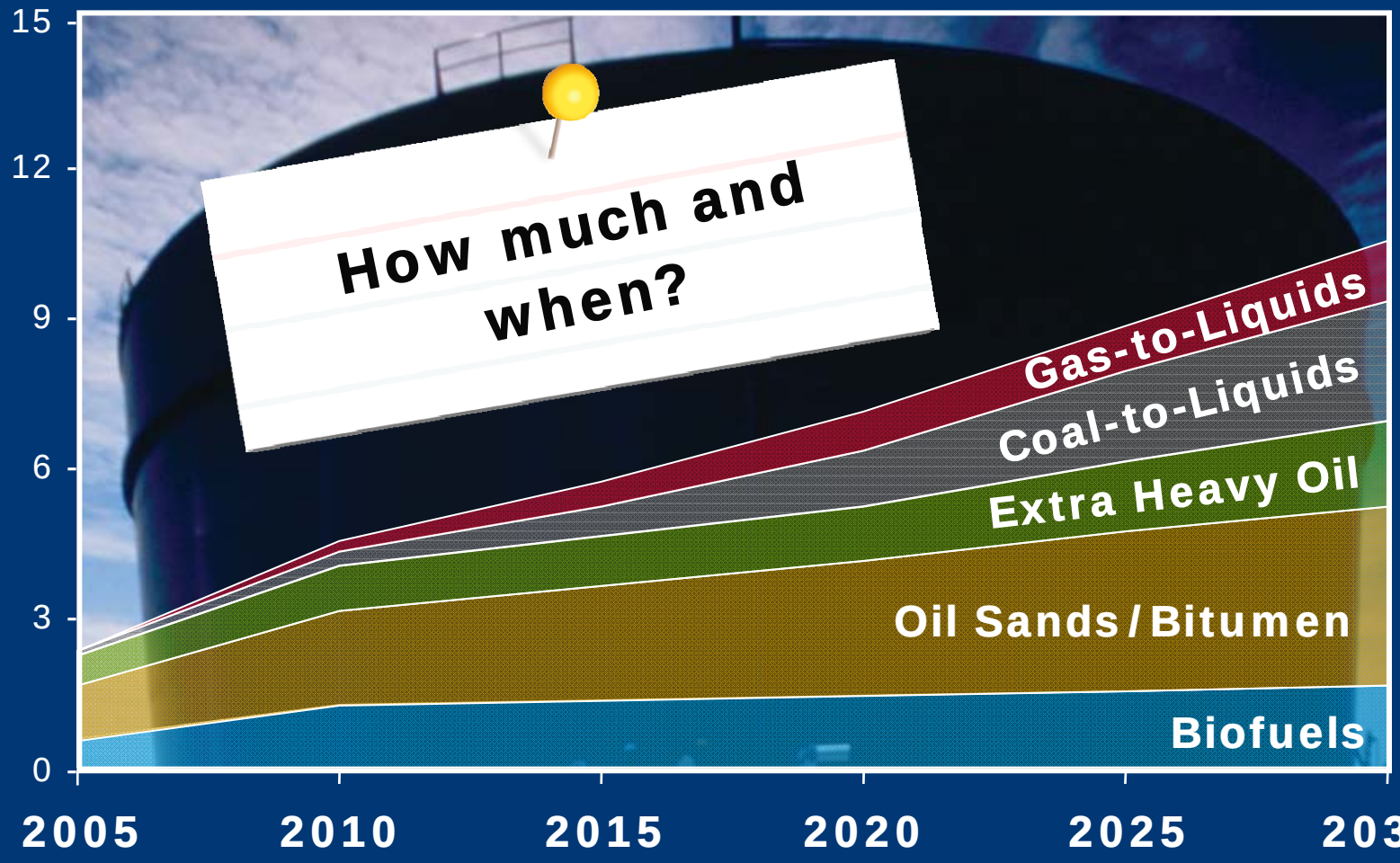

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Synthetic Alternative Fuels

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Advanced Biofuels Development

Industrial-scale Infrastructure

2nd Generation Technology

Large, concentrated supplies of feedstock

Key Components

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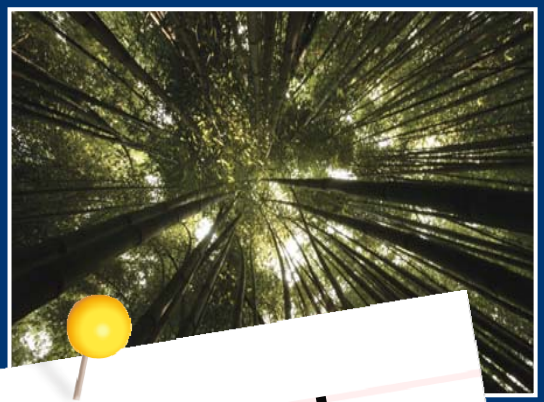
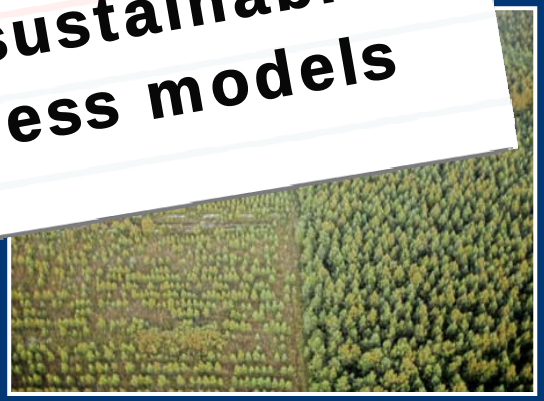




***Plus* sustainable business models**

Key Components

Feedstock Challenges

Develop cost-advantaged access to scalable feedstock supply to support industrial scale volumes:

- Scale and economic viability
- New vs. existing infrastructure
- Crop threats and seasonality
- Food vs. fuel competition
- Land availability
- Level and persistence of subsidies
- Water supplies
- LCA & LUC

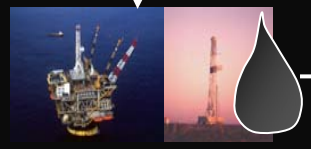
Algae, which require no arable land at all, potentially can produce much more oil per acre than any terrestrial crop.

However, algae is still some years from being a commercially viable feedstock source.

Conventional and Green Crude Process

Conventional Crude*

Bury, wait 50 million years



Explore, drill, produce — local infrastructure

*Stable, flowable, energy dense liquid

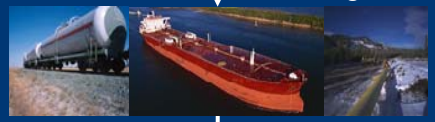
Pre-treat at refinery site as needed

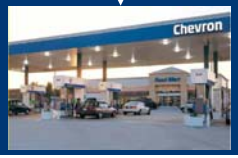
Distribute regionally through established infrastructure — pipeline, tanker, barge, or rail

Sunshine + water + CO_2 + nutrients + plant life

Transport over long distances — pipeline, tanker, barge, or rail

Refine into consistent, high-quality liquid fuel products — gasoline, diesel, etc.





Market via established network of service stations

Green Crude*

Harvest and gather — locally

Produce — local infrastructure

*Stable, flowable, energy dense liquid

Pre-treat at refinery site as needed

With all the excitement about alternative energy sources …

… it's important to keep perspective …

Courtesy of the Nebraska Historical Society

… and we're going to need it all.

Fundamentals of the Energy System

- A complex blend of economics, geopolitics, technology and the environment
- World's largest supply chain
- Highly integrated infrastructures
- Capital- and technology- intensive
- Very long-lived assets